CONTINUING MEDICAL EDUCATION

Rhegmatogenous Retinal Detachment—an Ophthalmologic Emergency

Nicolas Feltgen, Peter Walter

SUMMARY

Background: Rhegmatogenous retinal detachment is the most common retinological emergency threatening vision, with an incidence of 1 in 10 000 persons per year, corresponding to about 8000 new cases in Germany annually. Without treatment, blindness in the affected eye may result.

Method: Selective review of the literature.

Results: Rhegmatogenous retinal detachment typically presents with the perception of light flashes, floaters, or a "dark curtain." In most cases, the retinal tear is a consequence of degeneration of the vitreous body. Epidemiologic studies have identified myopia and prior cataract surgery as the main risk factors. Persons in the sixth and seventh decades of life are most commonly affected. Rhegmatogenous retinal detachment is an emergency, and all patients should be seen by an ophthalmologist on the same day that symptoms arise. The treatment consists of scleral buckle, removal of the vitreous body (vitrectomy), or a combination of the two. Anatomical success rates are in the range of 85% to 90%. Vitrectomy is followed by lens opacification in more than 70% of cases. The earlier the patient is seen by an ophthalmologist, the greater the chance that the macula is still attached, so that visual acuity can be preserved.

Conclusion: Rhegmatogenous retinal detachment is among the main emergency indications in ophthalmology. In all such cases, an ophthalmologist must be consulted at once.

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Retinal detachment is the term used to describe detachment of the neurosensory retina from the underlying membrane, the retinal pigment epithelium. The separation of the two layers takes place within the fissure formed by the invagination of the optic cup (e1).

Three forms of retinal detachment are distinguished:

- The most frequent is the rhegmatogenous form of detachment, in which a retinal tear allows liquefied vitreous humor to penetrate under the retina *(Figure 1)*.
- In the far less common tractional form, the retina is pulled away from the substrate by cord-like scars, e.g., fibrosing proliferation membranes in diabetic retinopathy.
- Much less frequent again is exudative retinal detachment; where the underlying cause is a barrier dysfunction, for example in the case of intraocular tumors or exudative vascular diseases.

The most common cause of rhegmatogenous retinal detachment is degeneration of the vitreous body. The vitreous is made up almost entirely (98%) of water and is stabilized by collagen fibrils that extend into the superficial (internal) layers of the retina (1, e2). Physiological degeneration of this vitreous scaffold has been demonstrated as early as the first few years of life (e3, e4). In the course of time the collagen fibrils harden, sometimes leading to perception of the mobile dots and threads known as muscae volitantes or "floaters" (e1). The progressive loss of elasticity eventually results in separation of the vitreous from the retina *(Figure 2a)*. This process is described as "posterior vitreous detachment." In this context, the risk that a tear will arise in the retina is most acute when the vitreous body is still attached to the retina at one or more points and its weight exerts traction *(Figure 2b)*. Because the vitreous usually begins to separate from the retina at the posterior pole of the eye, extending to the so-called

Definition

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equator, the tension on the retina is particularly strong in this region. The equator marks the transition of the central to the peripheral retina *(Figures 1, 2a, 3)* and is the point where the retina is at its thinnest (0.18 mm versus 0.23 mm at the center) (e5), which explains the predilection for tension-related holes in the retina *(Figures 1, 3, 4)*. Every fifth patient with posterior vitreous detachment develops a retinal hole (e6).

The incidence of rhegmatogenous retinal detachment in the general population in Europe is ca. 1 in 10 000, corresponding to around 8000 new cases each year in Germany (2, e7, e8). The danger is greatest in the age range 55 to 70 years. The risk of retinal detachment in the second eye is between 3.5% and 5.8% in the first year and 9% to 10% within 4 years; existing detachment in one eye is therefore the most frequent risk factor (2). There are typical risk factors that increase the danger of rhegmatogenous retinal detachment, principal among them shortsightedness, cataract surgery, and trauma. The higher incidence of retinal detachment in patients with these risk factors is attributed to points of particularly strong adhesion between the vitreous body and the retina (2).

Learning goals

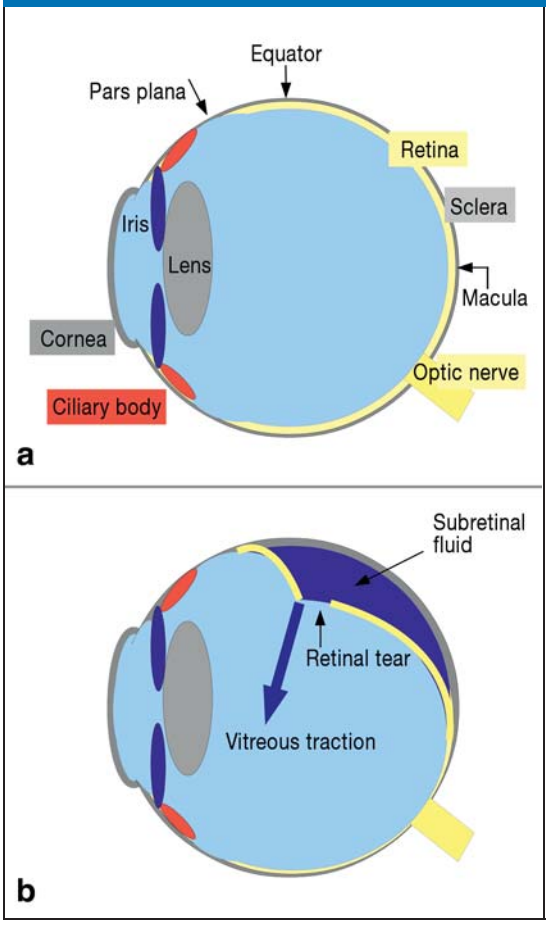
After reading this article, the reader should be able to:

- Interpret the possible symptoms of retinal detachment
- Name the treatment options
- Observe the rules of aftercare and recognize the typical postoperative features.

Literature review

We searched PubMed, Embase and the Cochrane Registry using the terms "retinal detachment," "rhegmatogenous retinal detachment," "scleral buckling," "vitrectomy," and "risk factors" and then made a representative (in our view) selection of the publications identified.

FIGURE 1



Schematic diagram of an eye. The anatomical structures are marked by color and/or an arrow. a) Normal eye with intact vitreous body. b) Eye with rhegmatogenous retinal detachment. Vitreous traction causes a tear in the retina through which fluid enters the subretinal space, resulting in detachment

Myopia

Shortsightedness of up to –3 diopters (D) quadruples the risk of retinal detachment, and myopia of more than –3 D increases the danger of detachment tenfold. Myopia also leads to earlier vitreous liquefaction, which explains why retinal detachment generally occurs earlier in shortsighted patients than in those without refraction defects (3, e8–e11). In various study groups, around 50% of all patients with rhegmatogenous retinal detachment were myopic (e12, e13). Myopia is a particularly relevant risk factor because it is increasingly more common among children (4, e14); every third European adult is now shortsighted (e14).

Previous surgery

Another risk factor for rhegmatogenous retinal detachment is operative insertion of an artificial lens. Cataract surgery accelerates liquefaction of the vitreous humor,

Incidence

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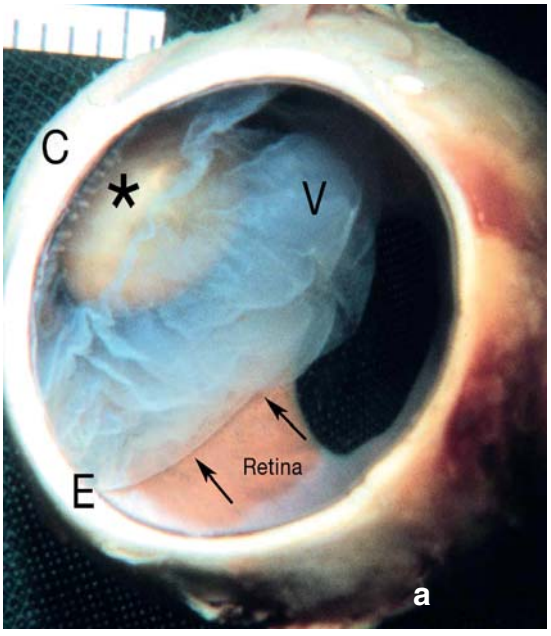

Figure 2a: Macroscopic view of an eyeball opened at both sides. C, Cornea; V vitreous body; E, equator; *, lens (loss of translucency due to fixation process); arrows: margin of anteriorly displaced vitreous (source: Prof. Peter Meyer, Kantonsspital Basel, Switzerland)

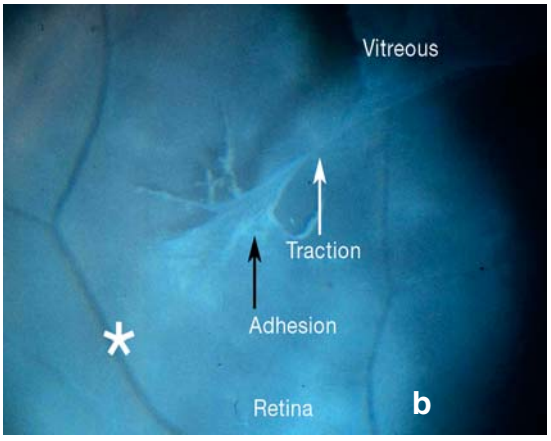

Figure 2b: Macroscopic view of an eye with vitreous traction on the retina that has not produced a retinal hole. White arrow: vitreous traction strand; black arrow: point of adhesion of vitreous to retina; *, retinal vessel (source: Prof. Peter Meyer, Kantonsspital Basel, Switzerland).

explaining the higher incidence of detachment. Six years after cataract surgery the risk of detachment is sevenfold, and the danger grows as the postoperative interval increases (e15). The risk of suffering rhegmatogenous retinal detachment after an uncomplicated cataract operation is approximately 1/1000 (2). Around 30% of patients with retinal detachment have a history of cataract surgery (3, 5–7, e16, e17). Some 650 000 cataract operations are carried out each year in Germany (8). Recent findings suggest that demographic developments will lead to an increase in the proportion of those with such surgery among patients with retinal detachment (8). However, the considerable technical advances in cataract surgery in the past few years make it difficult to predict future effects. The increased risk of retinal detachment should be explained to cataract patients before operation, but it should not be a reason for abandoning surgery that is otherwise indicated.

Trauma

The sudden acceleration of the vitreous body in blunt ocular trauma may lead to extensive tearing of the retina around the base of the vitreous far out in the periphery; alternatively, small holes may arise in the fundus of the eye. The rate of traumatic retinal detachment is comparatively low, at 0.2/10 000 (2).

Ophthalmologists are often asked whether pregnant women with myopia or retinal detachment can be advised to give birth naturally or whether a cesarean section would be preferable. There is now a clear answer to this question: Provided the retina is currently attached, neither shortsightedness nor a history of rhegmatogenous retinal detachment speaks against natural childbirth (9, e18).

A subject of ongoing investigation is whether oral intake of fluoroquinolones (particularly ciprofloxacin) leads to increased incidence of retinal detachment. In a Canadian database study, the rate of detachment during drug intake was 5 times higher than in a control group (10). Over the course of the 8-year observation period (from 2000 to 2007), a cohort of almost a million persons was evaluated. A total of 4384 experienced a retinal detachment during this time. The proportion of persons who had taken fluoroquinolones was 3.3% in the detachment group versus 0.6% in the control group (n = 43 840). This possible effect is explained by accelerated vitreous liquefaction with subsequent retinal tearing. No prospective studies on this topic have been published. To date, the data do not justify a

Risk after cataract surgery

Six years after cataract surgery the risk of detachment is sevenfold, and the danger grows as the postoperative interval increases.

Myopia and childbirth

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recommendation to avoid taking fluoroquinolones, even in patients with recognized risk factors for retinal detachment; however, patients should be advised of the potential dangers.

Clinical findings and examination

Most patients report abnormal visual phenomena before the actual detachment of the retina. These can take the form of newly occurring opacities described as cobwebs or threads, sometimes as a swarm of midges. Occasionally the patient perceives flashes of light that can be provoked by changing the direction of gaze. Sometimes the patient has difficulty determining which eye is affected. If the retina then becomes detached, the patient perceives a light to dark gray shadow; in rare cases the shadow is completely black. In contrast to vitreous opacity, this shadow does not move when the direction of gaze changes. If the retinal detachment extends to the optic fovea or the visual axis is occluded, considerable worsening of vision ensues. Occasionally vascular tears result in vitreous hemorrhages, again leading to impairment of vision. Examination of the background of the eye (funduscopy) takes in the entire retina from the posterior pole to the ora serrata. A detachment is recognized by the dune-like appearance and mobility of the retina, and the hole responsible for the detachment can often be discerned *(Figures 3, 4)*. The hole may be more difficult to find, however, particularly after cataract operations; in ca. 5% to 20% of patients with retinal detachment following cataract surgery the very small and peripherally located holes are overlooked preoperatively (e19, e20).

Attentive patients usually notice the visual symptoms very quickly, but do not always recognize their importance or attach much urgency to them. Most patients present with a detached macula and therefore have an unfavorable prognosis from the outset (11–13, e21). It has been estimated that between 50% and 70% of patients present too late because they did not recognize the typical symptoms of detachment; this is independent of educational level (e22, e23). It is therefore especially important to ensure that high-risk patients are informed accordingly.

Treatment options

Typically, retinal detachment is treated by mechanical and scar-induced sealing of all holes in the retina. Jules Gonin was the first to recognize that hole closure forms an essential part of the treatment of retinal detachment

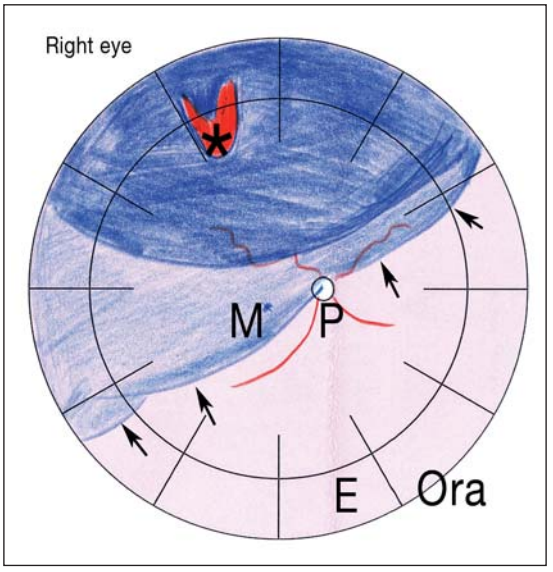

Figure 3: Sketch of fundus in detachment with a superotemporal U-shaped hole. The arrows indicate the margin of detachment. Blue, area of detachment; red, attached retina; E, equator, Ora, ora serrata; M, macula; P, papilla; *, U-shaped hole exposing the choroid membrane under the retina

(e24–e27). Several different procedures are now available and can be used singly or in combination: laser coagulation or cryocoagulation for scar induction and scleral buckling or vitrectomy to close the holes.

In laser coagulation the laser light enters the eye via the pupil. The laser energy is absorbed in the retinal pigment epithelium, leading to heat (ca. 60 °C) and coagulation necrosis (e28, e29). Cryocoagulation involves freezing of the eyeball all the way from the outside to the retina by application of a cryo probe (ca. –80 °C). Both procedures are followed after a few days by formation of a scar, but only if the retina is in contact with the underlying retinal pigment epithelium. Therefore, scar induction by either laser coagulation or cryocoagulation is effective only for prevention of detachment in a still-attached retina; both forms of coagulation are pointless if detachment has already occurred.

The procedures employed for surgical management of retinal detachment are scleral buckling and vitrectomy. Here too laser coagulation or cryocoagulation is used for hole closure, but only after surgery to repair the detachment. Data for both of these surgical options

First symptoms

Most patients report abnormal visual phenomena before the actual detachment of the retina. These can take the form of newly occurring opacities described as cobwebs or threads.

Funduscopy

A detachment is recognized by the dune-like appearance and mobility of the retina, and the hole responsible for the detachment can often be discerned.

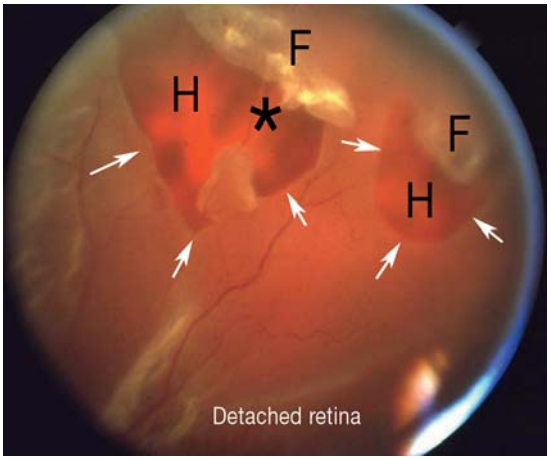

Figure 4: Retinal detachment with two U-shaped holes. H, Retinal hole; F, covering flap; *, bridging artery stabilizing the flap at its apex; arrows, hole margins

are available from recent prospective randomized clinical trials.

Scleral buckling

After precise localization of all retinal breaks and marking of the sclera, the holes are treated with cryopexy for scar induction. The traction exerted on the holes by the vitreous body is then reduced by a foam sponge sutured to the sclera (14) *(Figure 5)*.

In certain configurations of retinal holes or in the presence of multiple breaks, a silicone band can be placed around the whole eyeball; this is known as encircling band. When the buckling has abolished the traction effect on the holes, the retinal pigment epithelium absorbs the subretinal fluid and the retina becomes reattached in the space of a few days. Depending on the situation, a single scleral buckling procedure achieves reattachment rates of ca. 85% to 90% (11, 13, 15–17, e30–e32). A frequent complication of scleral buckling procedures is deformation of the eyeball with changes in refraction. In practice this is a problem only with cerclage, hardly ever occurring with a sponge (e33, e34). Double vision and eye movement problems are each reported in around 15% of cases early after operation (18). Occasionally the sponge becomes infected (0.3% [e35]) or migrates into the eyeball (<0.01% [14]). In the vast majority of cases the symptoms recede after a few days or weeks, so that neither sponges nor cerclages are removed.

Vitrectomy

Vitrectomy begins with the removal of the vitreous humor causing the retinal detachment, followed by displacement of the subretinal fluid by means of a heavy tamponade (perfluorodecalin or perfluorocarbon) and scarring of the retina by laser coagulation or cryocoagulation. The vitreous is then replaced by a tamponade *(Figure 6)*, which holds the retina against the underlying retinal pigment epithelium until a firm scar has formed around the retinal hole. A mixture of air and gas or a silicone oil tamponade can be chosen for this purpose. The air/gas mixture is usually chosen in simpler situations (e.g., when the hole is at the top of the eyeball). The advantage of the air/gas tamponade is that it is absorbed and thus does not require removal. The disadvantage is that the mixture expands postoperatively (due to warming and uptake of nitrogen from the blood), with the danger of pressure decompensation, so the patient should avoid changes in altitude—not only flights but also mountain crossings. Furthermore, air/gas mixtures result in a massive change in refraction of ca. –50 D (e36). The gases most frequently used are sulfur hexafluoride (SF6), perfluoroethane (C2F6), and perfluoropropane (C3F8). How long the gas remains in the eye depends on which gas is chosen, how much of it is injected, and on the intraocular pressure. On average the gases remain in the eye for between 14 days (SF6) and 2 months (C3F8) (19, e37).

In complicated situations silicone oil can be used as tamponade. The advantage of oil is that the tamponade is stable, without expansion, while the disadvantage is the necessity for surgical removal. Moreover, oil causes a change in refraction of around +6 D, leading to blurred vision. Reattachment rates of 85% to 90% are also reported for vitrectomy (1, 5, 11, 13, 16, 17, 20, e30–e32). The frequent complications are cataract in the first year after surgery (77% [13]) and unintentional creation of retinal holes during surgery (up to 17% [21]). Rare complications include bleeding into the vitreous humor, in around 1% of cases (22), and inflammation of the inner eye, even endophthalmitis, although the latter is very rare indeed (<0.01%) (22). The technical advances in minimally invasive trocar-guided vitrectomy *(Figure 6)* have had no effect on the endophthalmitis rate (e38–e40), but have reduced the rate of iatrogenic retinal holes by a factor of 4 (21, e41). Nevertheless, the classic method continues to be used in parallel with the minimally invasive technique

Surgical management

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because no firm conclusions can yet be drawn with regard to benefits and drawbacks.

The operations can be performed with the patient under retrobulbar local anesthesia or general anesthesia, although the latter is preferable particularly for scleral buckling. It is important to note that nitrous oxide anesthesia must be avoided if an air/gas mixture is being used for internal tamponade, as otherwise the intraocular pressure rises so high that blindness can result (19, e42, e43).

Aftercare and postoperative features

There is no rigid scheme for postoperative care that can be applied to every patient. In the first few weeks after operation the patient is examined by an ophthalmologist at short intervals, the frequency depending on the findings. The most important period is the first 6 weeks, during which most complications occur. One significant complication after surgical interventions is scarring of the retina. In proliferative vitreoretinopathy (PVR) fibrotic membranes form on, under, or within the retina, leading to hardening and mechanical shortening of the retina and elevation from the sclera (e1). Regardless of the procedure used, PVR occurs in around 15% of cases and is more pronounced in younger patients and in those with more advanced disease (with literature reports varying from 7% to 55%) *(Table)* (13, e44, e45).

In a PVR reaction the typical symptoms of "flashes of light and smoke signals," the correlate of vertical vitreous traction on the retina, are absent. Should the PVR reaction detach the retina close to the fovea, however the patient again describes a renewed shadow and loss of vision (e46).

In the postoperative phase patients are restricted in their activities by local symptoms (swelling, reddening, pain), impaired visual acuity with tamponade, and by the necessity of using eye drops. The transitory (tamponade) or persisting (injury of the macula or optic nerve) loss of spatial vision leads to problems for many patients in the first few weeks, particularly with near work. This should be considered and discussed during the rehabilitation period.

Stage-appropriate treatment and study findings

Changes or rhegmatogenous retinal hole without detachment

An incidentally discovered retinal hole without detachment does not always require treatment. There is no consensus regarding interpretation of the available data on peripheral retinal degeneration, which has traditionally been seen as a risk factor for detachment. The principal representative of this group of changes is lattice degeneration, which is found in around 7% of the normal population but in up to 46% of patients with retinal detachment (2, 23, 24, e47). The likelihood that detachment will develop from asymptomatic lattice degeneration is less than 1%, however, so general prophylactic laser coagulation is currently not recommended—except in the presence of risk factors that favor detachment (status post trauma, detachment in the other eye, family history of detachment) (25). Nevertheless, a Cochrane Review published in 2012 underlined the low evidence level of the available data and the difficulty of formulating reliable recommendations (e48).

In contrast, holes found in a symptomatic patient whose retina is still attached but who is at increased risk of detachment should be treated by laser coagulation according to the published recommendations (25, e49, e50).

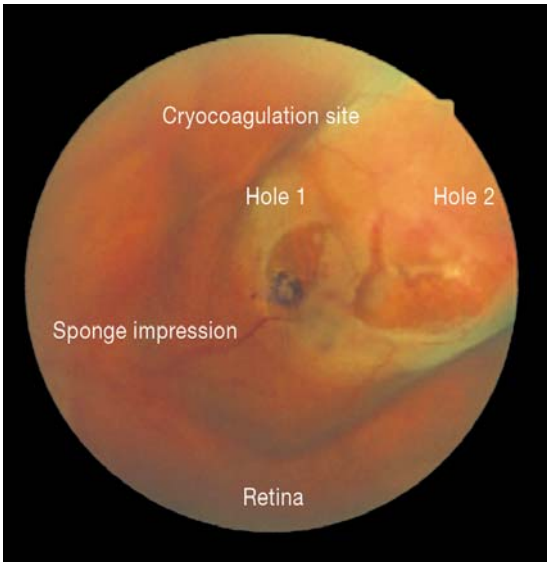

Figure 5: Sponge under double hole. Owing to cryocoagulation the edge of the hole is whiter than the rest of the retina. From this perspective the sponge, sutured externally onto the sclera, can be seen indirectly as a concavity of the retina

Rhegmatogenous retinal hole with detachment

The surgical management of retinal detachment has changed considerably in recent years. While most

Disadvantage of air/gas mixture in vitrectomy

Pressure decompensation should be avoided. Patients should not make any journeys that involve changes in altitude—particularly flights but also mountain crossings.

Postoperative period

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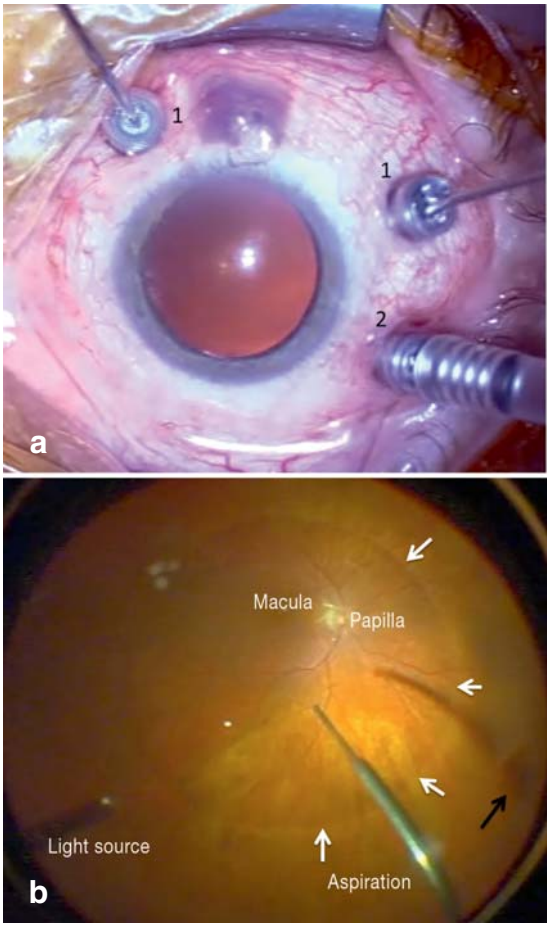

Figure 6: Vitrectomy in retinal detachment.
a) External view of eye with three access ports.
1: Ports for vitrectome and light; 2: port for intraocular fluid.
b) Intraocular view. The retina is reattached; in the center a black fluid (perfluorodecalin) has been poured in to help keep the retina adjacent to the underlying membrane. The white arrows mark the margin of the bubble of intraocular fluid; the black arrow indicates the retinal hole

patients used to be treated by scleral buckling, vitrectomy now predominates (26, 27, e51–e53). Comparative studies have shown that both methods remain valid and each has clear indications, but also that they can be carried out simultaneously or successively (13, 16, 26, 28–30, e52). Apart from the surgeon's personal experience with the two types of operation, the choice of procedure depends principally on the precise findings in the individual patient (24). In the following simple situation, buckling is preferable to vitrectomy:

- Eye with native lens (phakic), no previous surgery (14–17, 31–33, e54)
- Hole clearly discernible, not too large (12, 34)
- No or only slight PVR reaction (12, 16, 34)
- Good view of site.

This is the case in almost half of all patients with retinal detachment (5). One quarter of patients, however, exhibit complicating factors at the time of presentation (5); in such cases vitrectomy is superior to buckling procedures (e55). Thanks to a prospective randomized European trial (SPR Study), we now have robust data to resolve the question of the best treatment for the remaining patients following cataract surgery: In most patients with retinal detachment after intraocular lens insertion (so-called pseudophakic detachment), vitrectomy is superior to scleral buckling or cerclage (13, 35). In eyes with the native lens, however, buckling procedures obtained better results with regard to the rate of reoperation (e31). Therefore, the lens status influences the choice of operation. The *Table* shows the most important anatomical and functional parameters of the prospective randomized trials published to date, divided by lens status (31).

An important question—and a common reason for litigation—is the timing of surgical intervention. This is always critical in patients with retinal detachment, because the longer the photoreceptors are separated from the retinal pigment epithelium, the greater the structural alterations in the retina and the potential functional impairments. The mean final visual acuity of patients whose macula was still attached at the time of operation corresponds approximately to the preoperative value, but those with macular detachment attain a mean acuity of only 0.1 to 0.2 (39). This is too low to read normal newspaper text (which requires acuity of ca. 0.5). Therefore, progression of detachment to the macula must be prevented. The available literature offers little information from which conclusions can be drawn regarding the speed of progression of retinal detachment

Rhegmatogenous retinal hole without detachment

An incidentally discovered retinal hole without detachment does not always require treatment.

Rhegmatogenous retinal hole with detachment

While most patients used to be treated by scleral buckling, vitrectomy now predominates. Studies show that both methods remain valid and each has clear indications.

TABLE

The principal anatomical and functional parameters of the prospective randomized trials published to date. Divided according to lens status

Author Year Design	Number of patients (n)	Surgical procedure (vitrectomy/ buckling)	Follow-up (months)	Primary attachment rate (vitrectomy/ buckling in% [p])	Final attachment rate (vitrectomy/ buckling in% [p])	Vision stabilized or improved (vitrectomy/ buckling in% [p])	Postoperative PVR (vitrectomy/ buckling in% [p])
Lens status: phakic							
Azad (36) 2007 RCT	61	30/31	6	80/81 [0.95]	100/100	97/94 [0.57]	10/0 [0.07]
Koriyama (37) 2007 RCT	46	23/23	36	91/91 [1.0]	100/100	100/91 [0.15]	9/4 [0.55]
Heimann (13) 2007 RCT	415	207/209	12	64/64 [0.99]	97/97 [0.98]	**75/88 [0.001]***	16/12 [0.25]
Lens status: pseudophakic/aphakic							
Ahmadieh (28) 2005 RCT	225	99/126	6	63/68 [0.38]	92/85 [0.11]	65/67 [0.75]	35/29 [0.34]
Sharma (38) 2005 RCT	50	25/25	6	84/76 [0.48]	100/100	96/96 [1.0]	4/20 [0.08]
Brazitikos (29) 2005 RCT	150	75/75	12	**95/83 [0.02]****	99/95 [0.17]	97/95 [0.41]	4/5.3 [0.7]
Heimann (13) 2007 RCT	265	132/133	12	**72/53 [0.002]****	96/93 [0.43]	86/81 [0.26]	15/23 [0.12]

The principal anatomical and functional parameters of published prospective randomized studies according to Sun et al. (31).
Top: phakic patients; bottom: pseudophakic/aphakic patients.
Blue (*): significant difference in favor of buckling procedures; red (**) significant difference in favor of vitrectomy.
RCT = randomized controlled trial; PVR = proliferative vitreoretinopathy

(e56, e57). Many different parameters play a part: A detachment in the upper half of the eye with a large U-shaped hole typically behaves more aggressively than a detachment in the lower hemisphere with small holes and a largely attached vitreous, as is often found, for example, in young shortsighted patients. Recent studies indicate that the surgical management of retinal detachment can be planned according to the individual situation (e.g., anticoagulation), considering that emergency management is associated with a higher rate of complications (39, 40, e57). In many cases flattening of the detached retina can be achieved by strict positioning of the patient on the side of the hole responsible for the detachment, thus facilitating surgical intervention (e57). If the macula is already detached, an operation in the next few days can be arranged (40).

Perspective

With the aim of further improving the operative management of retinal detachment, an ongoing multicenter prospective randomized trial at German retinal surgery centers, supported by a competence network for clinical studies in retinology (retina.net; in German), is investigating whether a combination of scleral buckling procedures and vitrectomy can yield a better outcome

Choice of procedure

In most patients with retinal detachment after intraocular lens insertion (so-called pseudophakic detachment), vitrectomy is superior to scleral buckling.

Timing of surgery

The timing of surgical intervention is critical in patients with retinal detachment, because the longer the photoreceptors are separated from the retinal pigment epithelium, the greater the structural alterations in the retina.

than vitrectomy alone in the difficult group of patients with retinal detachment following cataract surgery. The first results are expected in 2014.

Conflict of interest statement
The authors declare that no conflict of interest exists.

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REFERENCES

1. Mitry D, Fleck BW, Wright AF, Campbell H, Charteris DG: Pathogenesis of rhegmatogenous retinal detachment: predisposing anatomy and cell biology. Retina 2010; 30: 1561–72.
2. Mitry D, Charteris DG, Fleck BW, Campbell H, Singh J: The epidemiology of rhegmatogenous retinal detachment: geographical variation and clinical associations. Br J Ophthalmol 2010; 94: 678–84.
3. Mitry D, Singh J, Yorston D, Siddiqui MAR, Wright A, Fleck BW, et al.: The predisposing pathology and clinical characteristics in the Scottish retinal detachment study. Ophthalmology 2011; 118: 1429–34.
4. Morgan IG, Ohno-Matsui K, Saw SM: Myopia. Lancet 2012; 379: 1739–48.
5. Feltgen N, Weiss C, Wolf S, Ottenberg D, Heimann H: Scleral buckling versus primary vitrectomy in rhegmatogenous retinal detachment study (SPR Study): recruitment list evaluation. Study report no. 2. Graefes Arch Clin Exp Ophthalmol 2007; 245: 803–9.
6. Mitry D, Chalmers J, Anderson K, Williams L, Fleck BW, Wright A, et al.: Temporal trends in retinal detachment incidence in Scotland between 1987 and 2006. Br J Ophthalmol 2011; 95: 365–9.
7. Herrmann W, Helbig H, Heimann H: Pseudophakieablatio. Klin Monatsblätter Für Augenheilkd 2011; 228: 195–200.
8. Wolfram C, Pfeiffer N: Weißbuch zur Situation der ophthalmologischen Versorgung in Deutschland. 2012th ed. München 2012.
9. Hart NC, Jünemann AGM, Siemer J, Meurer B, Goecke TW, Schild RL: Geburtsmodus bei präexistenten Augenerkrankungen. Z Für Geburtshilfe Neonatol 2007; 211: 139–41.
10. Etminan M, Forooghian F, Brophy JM, Bird ST, Maberley D: Oral fluoroquinolones and the risk of retinal detachment. JAMA 2012; 307: 1414–9.
11. D'Amico DJ: Clinical practice. Primary retinal detachment. N Engl J Med 2008; 359: 2346–54.
12. Feltgen N, Heimann H, Hoerauf H, Walter P, Hilgers RD, Heussen N: Scleral buckling versus primary vitrectomy in rhegmatogenous retinal detachment study (SPR study): Risk assessment of anatomical outcome. SPR study report no. 7. Acta Ophthalmol 2013; 91: 282–7.
13. Heimann H, Bartz-Schmidt KU, Bornfeld N, Weiss C, Hilgers RD, Foerster MH: Scleral buckling versus primary vitrectomy in rhegmatogenous retinal detachment: a prospective randomized multicenter clinical study. Ophthalmology 2007; 114: 2142–54.
14. Hoerauf H, Heimann H, Hansen L, Laqua H: Skleraeindellende Ablatiochirurgie und pneumatische Retinopexie. Techniken, Indikationen und Ergebnisse. Ophthalmologe 2008; 105: 7–18.
15. De la Rúa ER, Pastor JC, Fernández I, Sanabria MR, García-Arumí J, Martínez-Castillo V, et al.: Non-complicated retinal detachment management: variations in 4 years. Retina 1 project; report 1. Br J Ophthalmol 2008; 92: 523–5.
16. Pastor JC, Fernandez I, Rodriguez de la Rua E, Coco R, Sanabria-Ruiz Colmenares MR, Sanchez-Chicharro D, et al.: Surgical outcomes for primary rhegmatogenous retinal detachments in phakic and pseudophakic patients: the Retina 1 Project-report 2. The British Journal of Ophthalmology 2008; 92: 378–82.
17. Haritoglou C, Brandlhuber U, Kampik A, Priglinger SG: Anatomic success of scleral buckling for rhegmatogenous retinal detachment-a retrospective study of 524 cases. Int J Ophthalmol 2010; 224: 312–8.
18. Framme C, Roider J, Hoerauf H, Laqua H: Komplikationen nach externer Netzhautchirurgie bei Pseudophakieablatio – Sind eindellende Operationsverfahren noch aktuell? Klin Monatsblätter Für Augenheilkd 2000; 216: 25–32.
19. Silvanus MT, Moldzio P, Bornfeld N, Peters J: Visual loss following intraocular gas injection. Dtsch Arztebl Int 2008; 105(6):108–12.
20. Heimann H, Zou X, Jandeck C, Kellner U, Bechrakis NE, Kreusel KM, et al.: Primary vitrectomy for rhegmatogenous retinal detachment: an analysis of 512 cases. Graefes Arch Clin Exp Ophthalmol 2006; 244: 69–78.
21. Jalil A, Ho WO, Charles S, Dhawahir-Scala F, Patton N: Iatrogenic retinal breaks in 20-G versus 23-G pars plana vitrectomy. Graefes Arch Clin Exp Ophthalmol 2013; 251: 1463–7.
22. Heussen N, Hilgers RD, Heimann H, Collins L, Grisanti S: Scleral buckling versus primary vitrectomy in rhegmatogenous retinal detachment study (SPR study): multiple-event analysis of risk factors for reoperations. SPR Study report no. 4. Acta Ophthalmol (Copenh) 2011; 89: 622–8.
23. Byer NE: Subclinical retinal detachment resulting from asymptomatic retinal breaks: prognosis for progression and regression. Ophthalmology 2001; 108: 1499–503; discussion 1503–4.
24. Mitry D, Awan MA, Borooah S, Siddiqui MAR, Brogan K, Fleck BW, et al.: Surgical outcome and risk stratification for primary retinal detachment repair: results from the Scottish Retinal Detachment study. Br J Ophthalmol 2012; 96: 730–4.
25. Heimann H: Netzhautablösung: Therapeutisches Vorgehen. Augenheilkunde up2date 2012: 243–59
26. Arya AV, Emerson JW, Engelbert M, Hagedorn CL, Adelman RA: Surgical management of pseudophakic retinal detachments: a meta-analysis. Ophthalmology 2006; 113: 1724–33.
27. Ho JD, Liou SW, Tsai CY, Tsai RJF, Lin HC: Trends and outcomes of treatment for primary rhegmatogenous retinal detachment: a 9-year nationwide population-based study. Eye Lond Engl 2009; 23: 669–75.
28. Ahmadieh H, Moradian S, Faghihi H, Parvaresh MM, Ghanbari H, Mehryar M, et al.: Anatomic and visual outcomes of scleral buckling versus primary vitrectomy in pseudophakic and aphakic retinal detachment: six-month follow-up results of a single operation-report no. 1. Ophthalmology 2005; 112: 1421–9.
29. Brazitikos PD, Androudi S, Christen WG, Stangos NT: Primary pars plana vitrectomy versus scleral buckle surgery for the treatment of pseudophakic retinal detachment: a randomized clinical trial. Retina 2005; 25: 957–64.

Improvement of the initial situation

In many cases flattening of the detached retina can be achieved by strict positioning of the patient on the side of the hole responsible for the detachment, thus facilitating surgical intervention.

30. Adelman RA, Parnes AJ, Ducournau D: Strategy for the Management of Uncomplicated Retinal Detachments: The European Vitreo-Retinal Society Retinal Detachment Study Report 1. Ophthalmology 2013; 120: 1804–8.
31. Sun Q, Sun T, Xu Y, Yang X-L, Xu X, Wang BS, et al.: Primary vitrectomy versus scleral buckling for the treatment of rhegmatogenous retinal detachment: a meta-analysis of randomized controlled clinical trials. Curr Eye Res 2012; 37: 492–9.
32. Thelen U, Amler S, Osada N, Gerding H: Outcome of surgery after macula-off retinal detachment – results from MUSTARD, one of the largest databases on buckling surgery in Europe. Results from a large German case series. Acta Ophthalmol 2012; 90: 481–6.
33. Kreissig I: View 1: Minimal segmental buckling without drainage. Br J Ophthalmol 2003; 87: 782–4.
34. Heussen N, Feltgen N, Walter P, Hoerauf H, Hilgers RD, Heimann H: Scleral buckling versus primary vitrectomy in rhegmatogenous retinal detachment study (SPR Study): predictive factors for functional outcome. Study report no. 6. Graefes Arch Clin Exp Ophthalmol 2011; 249: 1129–36.
35. Heimann H, Hellmich M, Bornfeld N, Bartz-Schmidt KU, Hilgers RD, Foerster MH: Scleral buckling versus primary vitrectomy in rhegmatogenous retinal detachment (SPR Study): design issues and implications. SPR Study report no. 1. Graefes Arch Clin Exp Ophthalmol 2001; 239: 567–74.
36. Azad RV, Chanana B, Sharma YR, Vohra R: Primary vitrectomy versus conventional retinal detachment surgery in phakic rhegmatogenous retinal detachment. Acta Ophthalmologica 2007; 85: 540–5.
37. Koriyama M, Nishimura T, Matsubara T, Taomoto M, Takahashi K, Matsumura M: Prospective study comparing the effectiveness of scleral buckling to vitreous surgery for rhegmatogenous retinal detachment. Jpn J Ophthalmol 2007; 51: 360–7.
38. Sharma YR, Karunanithi S, Azad RV, Vohra R, Pal N, Singh DV, et al.: Functional and anatomic outcome of scleral buckling versus primary vitrectomy in pseudophakic retinal detachment. Acta Ophthalmol Scand 2005; 83: 293–7.
39. Diederen RMH, La Heij EC, Kessels AGH, Goezinne F, Liem ATA, Hendrikse F: Scleral buckling surgery after macula-off retinal detachment: worse visual outcome after more than 6 days. Ophthalmology 2007; 114: 705–9.
40. Henrich PB, Priglinger S, Klaessen D, Kono-Kono JO, Maier M, Schötzau A, et al.: Macula-off Ablatio retinae – eine Zeitfrage? Klin Monatsblätter Für Augenheilkd 2009; 226: 289–93.

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Please answer the following questions to participate in our certified Continuing Medical Education program. Only one answer is possible per question. Please select the answer that is most appropriate.

Question 1
What is the incidence of rhegmatogenous retinal detachment in the general population?
a) 1/1 000 000
b) 1/100 000
c) 1/10 000
d) 1/1 000
e) 1/100

Question 2
At what age do patients typically suffer a rhegmatogenous retinal detachment?
a) 15 to 30 years
b) 35 to 50 years
c) 55 to 70 years
d) 75 to 90 years
e) 95 to 105 years

Question 3
What is the principal cause of rhegmatogenous retinal detachment?
a) Glaucoma
b) Posterior vitreous detachment
c) Cataract
d) Corneal clouding
e) Pregnancy

Question 4
What is the most common ophthalmologic risk factor?
a) Myopia
b) Herpes dendritica
c) Keratoconus
d) Iritis
e) Retinal perfusion disorder

Question 5
What is the most frequent risk factor if one eye is already affected?
a) Amyloidosis
b) Viral infection
c) Herpes zoster
d) Fibromyalgia rheumatica
e) Known retinal detachment in the other eye

Question 6
What symptoms may point to impending retinal detachment?
a) Flashes of light and “smoke signals”
b) Pain
c) Vertigo
d) Double vision
e) Distorted vision

Question 7
How is retinal detachment usually diagnosed?
a) Computed tomography
b) High-resolution magnetic resonance imaging
c) Funduscopy
d) Skull X-ray
e) Optical coherence tomography

Question 8
What is the typical treatment after diagnosis of rhegmatogenous retinal detachment?
a) Observation and monitoring
b) Lateral positioning of the head and rest
c) Exercise therapy and reading
d) Scleral buckling procedures and/or vitrectomy
e) Systemic administration of fluoroquinolones

Question 9
What is most likely to lead to early detection of a retinal detachment?
a) Monthly ophthalmologic examination
b) Three-monthly ophthalmologic examination
c) Prophylactic lasering of all retinal degenerations
d) Regular wearing of visual aids (glasses, contact lenses)
e) Information of the patient about the symptoms of retinal detachment

Question 10
What is the mean visual acuity after rhegmatogenous retinal detachment with macular involvement (on the standard decimal scale, where 1.0 represents the mean full acuity)?
a) Blindness to 0.1
b) 0.1 to 0.2
c) 0.3 to 0.4
d) 0.6 to 0.8
e) 1.0

CONTINUING MEDICAL EDUCATION

Rhegmatogenous Retinal Detachment—an Ophthalmologic Emergency

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eREFERENCES

e1. Naumann G: Pathologie des Auges. 2nd ed. Berlin: Springer; 1997.

e2. Sebag J: Anatomy and pathology of the vitreo-retinal interface. Eye (London, England) 1992; 6: 541–52.

e3. Sebag J: Age-related changes in human vitreous structure. Graefe's archive for clinical and experimental ophthalmology = Albrecht von Graefes Archiv fur klinische und experimentelle Ophthalmologie 1987; 225: 89–93.

e4. Sebag J: Ageing of the vitreous. Eye (London, England) 1987; 1: 254–62.

e5. Apple DJ, Naumann GO: Spezielle Pathologie der Retina. In: Naumann GO, ed. Pathol Auges. 1st edition, Berlin, Heidelberg, New York: Springer-Verlag 1980: 577–667.

e6. Coffee RE, Westfall AC, Davis GH, Mieler WF, Holz ER: Symptomatic posterior vitreous detachment and the incidence of delayed retinal breaks: case series and meta-analysis. Am J Ophthalmol 2007; 144: 409–13.

e7. Van de Put MAJ, Hooymans JMM, Los LI, Dutch Rhegmatogenous Retinal Detachment Study Group: The incidence of rhegmatogenous retinal detachment in The Netherlands. Ophthalmology. 2013; 120: 616–22.

e8. Haimann MH, Burton TC, Brown CK: Epidemiology of retinal detachment. Arch Ophthalmol 1982; 100: 289–92.

e9. Wong TY, Tielsch JM, Schein OD: Racial difference in the incidence of retinal detachment in Singapore. Arch Ophthalmol 1999; 117: 379–83.

e10. Polkinghorne PJ, Craig JP: Northern New Zealand Rhegmatogenous Retinal Detachment Study: epidemiology and risk factors. Clin Experiment Ophthalmol 2004; 32: 159–63.

e11. Neuhann IM, Neuhann TF, Heimann H, Schmickler S, Gerl RH, Foerster MH: Retinal detachment after phacoemulsification in high myopia: analysis of 2356 cases. J Cataract Refract Surg 2008; 34: 1644–57.

e12. Schepens CL, Marden D: Data on the natural history of retinal detachment. I. Age and sex relationships. Arch Ophthalmol 1961; 66: 631–42.

e13. Cambiaggi A: Myopia and retinal detachment: statistical study of some of their relationships. Am J Ophthalmol 1964; 58: 642–50.

e14. Pan CW, Ramamurthy D, Saw S-M: Worldwide prevalence and risk factors for myopia. J Ophthalmic Physiol Opt 2012; 32: 3–16.

e15. Sheu S-J, Ger L-P, Ho W-L: Late increased risk of retinal detachment after cataract extraction. Am J Ophthalmol 2010; 149: 113–9.

e16. Ducournau DH, Le Rouic JF: Is pseudophakic retinal detachment a thing of the past in the phacoemulsification era? Ophthalmology 2004; 111: 1069–70.

e17. Saidkasimova S, Mitry D, Singh J, Yorston D, Charteris DG: Retinal detachment in Scotland is associated with affluence. Br J Ophthalmol 2009; 93: 1591–4.

e18. Papamichael E, Aylward GW, Regan L: Obstetric opinions regarding the method of delivery in women that have had surgery for retinal detachment. JRSM Short Reports 2011; 2: 24.

e19. Han DP, Rychwalski PJ, Mieler WF, Abrams GW: Management of complex retinal detachment with combined relaxing retinotomy and intravitreal perfluoro-n-octane injection. Am J Ophthalmol 1994; 118: 24–32.

e20. Yoshida A, Ogasawara H, Jalkh AE, Sanders RJ, McMeel JW, Schepens CL: Retinal detachment after cataract surgery. Surgical results. Ophthalmology 1992; 99: 460–5.

e21. Zou H, Zhang X, Xu X, Liu H, Bai L, Xu X: Vision-related quality of life and self-rated satisfaction outcomes of rhegmatogenous retinal detachment surgery: three-year prospective study. PIOS One 2011; 6: e28597.

e22. Quintyn JC, Benouaich X, Pagot-Mathis V, Mathis A: Retinal detachment, a condition little known to patients. Retina 2006; 26: 1077–8.

e23. Goezinne F, La Heij EC, Berendschot TTJM, et al.: Patient ignorance is the main reason for treatment delay in primary rhegmatogenous retinal detachment in the Netherlands. Eye Lond Engl 2009; 23: 1393–9.

e24. Gonin J: La pathogénie du décollement spontane de la rétine. Ann Docul 1904; 82: 30.

e25. Gonin J: Le traitement du décollement rétinien. Bull Soc Franc Ophtalmol 1920; 33: 1 (zitiert nach Freyler, 1982).

e26. Gonin J: Wie bringt man Netzhautrisse zum Verschluss? Ber Ophthalmol Ges Heidelb 1925; 46.

e27. Gonin J: Chirurgische Behandlung in Fällen von Netzhautablösung. Klin Mbl Augenheilk 1929; 83: 667.

e28. Brinkmann R, Koinzer S, Schlott K, et al.: Real-time temperature determination during retinal photocoagulation on patients. J Biomed Opt 2012; 17: 061219.

e29. Schlott K, Koinzer S, Ptaszynski L, et al.: Automatic temperature controlled retinal photocoagulation. J Biomed Opt 2012; 17: 061223.

e30. Barrie T: Debate overview. Repair of a primary rhegmatogenous retinal detachment. Br J Ophthalmol 2003; 87: 790.

e31. McLeod D: Is it time to call time on the scleral buckle? Br J Ophthalmol 2004; 88: 1357–9.

e32. Day S, Grossman DS, Mruthyunjaya P, Sloan FA, Lee PP: One-year outcomes after retinal detachment surgery among medicare beneficiaries. Am J Ophthalmol. 2010; 150: 338–45.

e33. Okamoto F, Yamane N, Okamoto C, Hiraoka T, Oshika T: Changes in higher-order aberrations after scleral buckling surgery for rhegmatogenous retinal detachment. Ophthalmology 2008; 115: 1216–21.

e34. Smiddy WE, Loupe DN, Michels RG, Enger C, Glaser BM, deBustros S: Refractive changes after scleral buckling surgery. Arch Ophthalmol 1989; 107: 1469–71.

e35. McMeel JW, Naegele DF, Pollalis S, Badrinath SS, Murphy PL: Acute and subacute infections following scleral buckling operations. Ophthalmology 1978; 85: 341–9.

e36. Whitacre MM: Principles and applications of intraocular gas. Butterworth-Heinemann Ltd (Januar 1998); 1998.

e37. Gedde SJ: Management of glaucoma after retinal detachment surgery. Curr Opin Ophthalmol 2002; 13: 103–9.

e38. Chen JK, Khurana RN, Nguyen QD, Do DV: The incidence of endophthalmitis following transconjunctival sutureless 25– vs 20-gauge vitrectomy. Eye Lond Engl 2009; 23: 780–4.

e39. Hu AYH, Bourges J-L, Shah SP, et al.: Endophthalmitis after pars plana vitrectomy a 20– and 25-gauge comparison. Ophthalmology 2009; 116: 1360–5.

e40. Bahrani HM, Fazelat AA, Thomas M, et al.: Endophthalmitis in the era of small gauge transconjunctival sutureless vitrectomy-meta analysis and review of literature. Semin Ophthalmol 2010; 25: 275–82.

e41. Cha DM, Woo SJ, Park KH, Chung H: Intraoperative iatrogenic peripheral retinal break in 23-gauge transconjunctival sutureless vitrectomy versus 20-gauge conventional vitrectomy. Graefes Arch Clin Exp Ophthalmol 2013; 251: 1469–74.

e42. Fu AD, McDonald HR, Eliott D, et al.: Complications of general anesthesia using nitrous oxide in eyes with preexisting gas bubbles. Retina 2002; 22: 569–74.

e43. Hart RH, Vote BJ, Borthwick JH, McGeorge AJ, Worsley DR: Loss of vision caused by expansion of intraocular perfluoropropane (C(3)F(8)) gas during nitrous oxide anesthesia. Am J Ophthalmol 2002; 134: 761–3.

e44. Asaria RH, Kon CH, Bunce C, et al.: How to predict proliferative vitreoretinopathy: a prospective study. Ophthalmology 2001; 108: 1184–6.

e45. Asaria RHY, Charteris DG: Proliferative vitreoretinopathy: developments in pathogenesis and treatment. Compr Ophthalmol Update 2006; 7: 179–85.

e46. Pastor JC: Proliferative vitreoretinopathy: an overview. Surv Ophthalmol 1998; 43: 3–18.

e47. Byer NE: Long-term natural history of lattice degeneration of the retina. Ophthalmology 1989; 96: 1396–401; discussion 1401–02.

e48. Wilkinson C: Interventions for asymptomatic retinal breaks and lattice degeneration for preventing retinal detachment. Cochrane Database Syst Rev 2001; 3.

e49. BVA: Leitlinie Nr.22 a Vorstufen einer rhegmatogenen Netzhautablösung bei Erwachsenen 2011.

e50. American Academy of Ophthalmology, Chew EY, Benson WE, Blodi BA, et al.: Posterior Vitreous Detachment, Retinal Breaks, and Lattice Degeneration 2008.

e51. Ah-Fat FG, Sharma MC, Majid MA, McGalliard JN, Wong D: Trends in vitreoretinal surgery at a tertiary referral centre: 1987 to 1996 [see comments]. Br J Ophthalmol 1999; 83: 396–8.

e52. Schwartz SG, Flynn HW: Primary retinal detachment: scleral buckle or pars plana vitrectomy? Current opinion in ophthalmology 2006; 17: 245–50.

e53. Falkner-Radler CI, Myung JS, Moussa S, et al.: Trends in primary retinal detachment surgery: results of a Bicenter study. Retina Phila Pa 2011; 31: 928–36.

e54. Thelen U, Amler S, Osada N, Gerding H: Success rates of retinal buckling surgery: relationship to refractive error and lens status: results from a large German case series. Ophthalmology 2010; 117: 785–90.

e55. Schwartz SG, Flynn HW Jr, Mieler WF: Update on retinal detachment surgery. Curr Opin Ophthalmol 2013; 24: 255–61.

e56. Wykoff CC, Smiddy WE, Mathen T, Schwartz SG, Flynn HW, Shi W: Fovea-sparing retinal detachments: time to surgery and visual outcomes. Am J Ophthalmol 2010; 150: 205–10 e2.

e57. Ho SF, Fitt A, Frimpong-Ansah K, Benson MT: The management of primary rhegmatogenous retinal detachment not involving the fovea. Eye Lond Engl 2006; 20: 1049–53.